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5 MAR 1991

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SUBJECT: Industrial Hygiene Air Sampling and Bulk Sampling Instructions

1. Enclosed is a copy of the updated U.S. Army Environmental Hygiene Agency's Technical Guide Number 141. This guide is intended to provide industrial hygienists with recommended sampling procedures for potentially hazardous chemical contaminants and with analytical methods on how to sample for chemical contaminants in air and bulk material.

2. Additional copies may be--

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c. Requested by electronic mail to hshbms@aeha1.apgea.army.mil

3. The technical point of contact is Ms R. Gaffney, Organic Environmental Chemistry Division, DSN 584-2208. The administrative point of contact is Ms H. Kurtz, DSN 584-4539 or commercial 301-671-4637.

FOR THE COMMANDER:

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*M. Barbara Weyandt*  
M. BARBARA WEYANDT  
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**ABERDEEN PROVING GROUND, MD 21010-5422**

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INDUSTRIAL HYGIENE AIR SAMPLING AND BULK  
SAMPLING INSTRUCTIONS

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Under the command jurisdiction of the U.S. Army Health Services Command, AEHA's mission is to support the worldwide preventive medicine programs of the Army and other Department of Defense and Federal agencies.

The Agency is unique with the variety of scientific disciplines working together in one military unit to protect the health and well being of soldiers and civilians and enhance the environment.

This is accomplished through support in environmental quality, occupational and environmental health, toxicology, radiation and entomological sciences, pest management, and laboratory services.

AEHA has direct support activities at Fort Meade, Fort McPherson, and Fitzsimons Army Medical Center. The main agency at Aberdeen Proving Ground performs larger consultations and specialized work.

Services are provided upon request. Since AEHA is mission funded, these services are free to Army installations. Projects with unusually large scopes or short time constraints may be conducted on a reimbursable basis.

The USAEHA is the proponent of this guide. Users are invited to send comments and suggested improvements on a DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to the Commander, U.S. Army Environmental Hygiene Agency, ATTN: HSHB-MS, Aberdeen Proving Ground, MD 21010-5422.

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Glossary



DEPARTMENT OF THE ARMY  
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REPLY TO  
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\* December 1990

USAEHA Technical Guide No. 141

Industrial Hygiene Air Sampling and Bulk Sampling  
Instructions

Chapter 1  
Introduction

1-1. Purpose

The purpose of this technical guide (TG) is to provide industrial hygienists (IHs) with recommended--

- a. Air sampling and bulk sampling procedures for potentially hazardous chemical contaminants.
- b. Analytical methods on how to sample for chemical contaminants in air and bulk material.

1-2. References

Publications are listed in appendix A.

1-3. Explanation of abbreviations

Abbreviations used in this TG are explained in the glossary.

Use of trademarked names does not imply endorsement by the U.S. Army, but is intended only to assist in identification of a specific product.

\* This TG supersedes TG-141, Industrial Hygiene Sampling Instructions, March 1987.

## Chapter 2 Air Sampling and Bulk Sampling Instructions

### 2-1. General sampling instructions

a. Industrial hygiene (IH) sampling procedures are summarized in tables B-1, B-2, and B-3.

(1) Table B-1 lists the chemical contaminant, sampling method, sampling rate or time, recommended sampling volume range in liters and a procedure number corresponding to those procedures performed at the U.S. Army Environmental Hygiene Agency, Aberdeen Proving Ground (USAEHA, APG). The procedure numbers are provided as guidance to the IHS serving USAEHA, APG, and do not apply to those methods used by USAEHA direct support activities (DSA). Appearing at the end of table B-1 are alternate sampling methods for several chemical parameters. These methods are to be used when submitting samples to the USAEHA-West laboratory for analysis of these parameters.

(2) The recommended sampling rates and air volumes listed in table B-1 are consistent with documented procedures published by the National Institute for Occupational Safety and Health (NIOSH), American Society for Testing and Materials (ASTM) and manufacturers of sampling media. Sampling done based on these recommendations will reasonably ensure that the accuracy and detection limit requirements of the analytical measurement system are met while also minimizing the potential for exceeding kinetic or saturation capacities of the sampling device(s). However, situations may arise which necessitate deviation from these guidelines. For example, a workplace may contain a sufficiently high concentration of a contaminant which requires the use of a lower-than-recommended flow rate in order to meet sampling time requirements, or may warrant a lower total sample volume; this is not uncommon with filter sampling in dusty areas. Similarly, pump or time constraints could conceivably lead to the need to sample a higher-than-recommended air volume. Since there is a safety factor built into the volume recommendation, there may be no problem with breakthrough; but remember that high humidity or the presence of additional adsorbing compounds could significantly reduce this safety factor. Therefore, while deviations from the recommended volumes may be made, such changes require the exercise of trained judgment and should be made only on an individual case basis.

(3) Table B-2 lists bulk sampling procedures for chemical contaminants. Details are given about container and sample size requirements.

(4) Table B-3 lists the sampling method, analytical method, coefficient of variation (CV), and reference and procedure numbers for those documentation procedures performed at USAEHA, APG. Equivalent documentation for the

procedures performed at the DSA should be obtained from their individual laboratories. The CVs included in table B-3 are given for the measurement system which includes the sampling and analytical method. Where sampling errors have not been determined, a 5 percent sampling error has been assumed and included with the analytical measurement error to produce the CV for the procedure. Some procedures listed in table B-3 are not validated (NV). These procedures are assumed to be state-of-the-art and the most reliable methods available; however, they have not undergone validation testing such as outlined by NIOSH in the Manual of the Analytical Methods, 3rd Edition. The gravimetric procedures employed at USA-EHA, APG are not considered validated because they deviate significantly from the NIOSH methods. Many chemical substances in the tables have the same USA-EHA, APG procedure number because they use the same analytical procedure for analysis.

b. Appendix C lists the IH monitoring supplies compatible with the procedures given in the sampling instructions in this TG. The supplies listed in the tables are intended only to assist in identifying a specific product. Other sources may be available for supplying equivalent items. Appendix C also lists the vendors who supply the items listed.

c. The supporting laboratory (see appendix D) should be contacted prior to sampling for contaminants whenever assistance is needed.

(1) Chemical contaminants not listed in table B-1 will only be analyzed with prior approval from the supporting laboratory.

(a) Continental United States (CONUS).

- USA-EHA, APG: For asbestos, quartz and metals, contact the Radiological and Inorganic Chemistry Division, DSN 584-2637. For organics, solvents, acid mists and pesticides, contact the Organic Environmental Chemistry Division, DSN 584-2208.

- Direct Support Activities: For metals, organics, and solvents, contact either USA-EHA-South, DSN 572-3234 or USA-EHA-West, DSN 943-8288.

(b) Outside Continental United States (OCONUS). Consult the appropriate supporting laboratory. See appendix D.

(2) Swipe, wipe and swab samples should not generally be submitted except by prior approval from the supporting laboratory. The sample collecting material very often presents interferences in analysis. Contact the appropriate laboratory for guidance on collecting swipe, wipe or swab samples.

## 2-2. Asbestos sampling

a. Asbestos samples are collected on 25 mm diameter, 0.45 um or 0.8 um pore size, cellulose esters (CE) filters in open-face cassettes with 50 mm extension cowls. Sample with the open end of the sampler facing downward. Use the 0.8 um pore size for personal sampling. The 0.45 um filters are recommended for sampling when performing transmission electron microscope (TEM) analysis. However, their higher pressure precludes their use with personal samplers. Do not use 37 um filters because sufficiently low detection limits may not be attained.

b. Adjust sampling flow rate for optimal filter loading using the guidance provided below:

(1) Occupational Safety and Health Administration (OSHA) regulations specify a sampling rate of 0.5 to 2.5 liters per minute (L/min). However, in order to obtain the optimal fiber loading for counting purposes for clean areas, a higher sampling rate (up to 16 L/min) is sometimes necessary. When available, refer to past sampling data to determine flow rate and time.

(2) The optimal sample loading is between 100 to 1300 fibers/mm<sup>2</sup> (f/mm<sup>2</sup>). Using past data expressed as fibers/cc, you can calculate f/mm<sup>2</sup> sample loading using the following formula:

$$\text{fibers/mm}^2 = \frac{(f/cc)(V)(1000)}{Ac}$$

Where: f/cc = fiber count result from past data  
V = volume sampled in liters  
Ac = 385 mm<sup>2</sup> for a 25 um filter

(3) Sample at a flow rate greater than .5 L/min. Use the formula below to calculate flow rates and time for sampling which controls the volume through the filter. Adjust the flow rate, Q (L/min), and time, t(min), to produce a fiber density, E, of 100 to 1300 fibers/mm<sup>2</sup> for optimum accuracy. Remember that the OSHA action level for aerosols being sampled is .1 fiber/cc (Federal Register, Vol. 51, No. 119, 20 Jun 86). A 25 um filter has an effective collection area Ac = 385 mm<sup>2</sup>.

Calculation:

$$\text{Volume} = Q (t) = \frac{Ac (E)}{f/cc (1000)}$$

(4) Most often sample volumes between 400 and 2000 liters are adequate. If samples are very clean and the volume is too low, results obtained may not be meaningful and not representative of the environmental conditions. They may be reported as less than the detection limit which may be higher than the action level (currently 0.1 f/cc). For example, a result of <0.25 f/cc.

Remember that detection limits are based on the volumes sampled and change accordingly.

(5) For expected low fiber concentrations (much less than 0.1 f/cc) in very clean environments, high volumes (3000 - 10,000 L) are required to achieve quantifiable loadings. Take care not to overload the filter with background dust which will bias the analysis and make it difficult to obtain accurate readings.

(6) For exceedingly dirty environments, it may be necessary to use less volume than the recommended 400 liters stated in table 8-1. As a safeguard, it is advisable to take some control samples using larger volumes just in case conditions are not as suspected.

(7) For episodic exposures, use high flow rates (7 - 16 L/min) over shorter times to meet appropriate filter loading requirements.

c. Submit at least two field blanks or 10 percent of the total samples, whichever is greater, for each set of samples. For a field blank, take a filter-loaded canister into the sample area at time of sampling, uncap and recap. DO NOT draw air through canister.

d. Ship samples in a rigid container with sufficient packing material to prevent jostling or damage. Do not use untreated polystyrene foam or packing material which has high electrostatic charge on its surface, because electrostatic forces may cause fiber loss from the sample filter to the sides of the cassette.

e. At USAEHA, all asbestos air samples are presently being analyzed by phase contrast microscopy. The laboratory anticipates having scanning and TEM analysis capabilities within the near future. Call DSN 584-2619 or commercial 301-671-2619 for status update.

f. If you plan to have samples analyzed by the USAEHA on a priority basis, please contact the asbestos lab (DSN 584-2619 or 301-671-2619) before sending them. All high priority samples must be accompanied by a letter specifying priority analysis and justifying the requirement. The letter should indicate the expected turnaround time of results and should be accompanied by AEHA Form 9-R. See appendix E. Mailing box should be marked PRIORITY/IN-HOUSE ANALYSIS. See appendix D for address.

### 2-3. Crystalline silica (quartz) sampling

a. Respirable quartz samples are collected on 37 mm diameter, 5 um pore size, polyvinyl chloride (PVC) membrane filters for x-ray diffraction analysis for weight of quartz present. Closed-faced sample cassettes are mounted in 10 mm nylon cyclones, and a minimum sample volume of 500 liters is collected at a flow rate of 1.7 L/min.

b. Crystalline silica samples can be examined qualitatively by x-ray diffraction for the presence of cristobalite or tridymite. However, the lack of suitable laboratory standards for these crystalline silica species precludes quantitative analysis.

#### 2-4. Filter sampling

a. Types of filters used are:

- (1) CE, a mixed cellulose ester filter (the same as cellulose nitrate).
- (2) Polyvinyl chloride (PVC)
- (3) Glass fiber (GF)
- (4) Polymer of tetrafluoroethylene (PTFE)

b. When sampling for metals, dust and oil mist, use the maximum sampling rate consistent with good pump operation to meet the minimum recommended volume for reliable analysis. However, care should be taken when collecting air samples for metals during sanding and grinding operations to avoid filter overloading, which may occur due to short-term generation of large volumes of material.

c. At least one field blank filter will be submitted with each set of samples from the same sampling series; if the number of samples in a set exceeds 10, then submit 1 blank for each 10 samples. Asbestos analysis requires a minimum of 2 blanks, and chromium VI, potassium hydroxide and sodium hydroxide require at least 3 blanks. When using preweighed filters, always use corresponding blank filters from the same lot as the samples. The lot can be determined from the code on the top of the USAEHA preweighed filter.

d. Some air contaminants may be collected and analyzed on the same filter. An example is the simultaneous sampling and analysis for lead and total chromium. The following list includes air contaminants which must be collected and analyzed on an individual basis:

- (1) Antimony.
- (2) Molybdenum.
- (3) Potassium hydroxide.
- (4) Sodium hydroxide.
- (5) Chromic acid mist.
- (6) Chromium VI.

e. Some PVC filters, specifically catalog number BSWP from Millipore<sup>®</sup> Corporation, are not acceptable for sampling chromium VI. This filter has been found to reduce a significant amount of the chromate spike. The NIOSH sampling method 7600 suggests use of catalog number FWSB (MSA) or number VM-1 (Gelman) or equivalent. The storage stability for chromium VI samples has been validated for only a 2-week holding time, therefore, USA-EHA should be notified of analytical requirements prior to the collection of samples.

## 2-5. Adsorption tube sampling

a. Various types of adsorption tubes are used according to the contaminant being sampled; some of these are charcoal, Tenax<sup>®</sup>, silica gel, Florisil<sup>®</sup>, and XAD-2<sup>®</sup>. Appendix B lists the contaminants and corresponding adsorption tubes. Appendix C lists the sources for consumable supplies (containers, filters, passive monitors, sampler types).

b. Smaller type charcoal tubes (150 mg) may be substituted for the 600 mg tubes listed in table B-1. (Note: The 600 mg tubes are 200/400 mg tube section.) However, correspondingly lower air volumes and sampling rates must be used (no more than one-half of the maximum volume and one half the maximum sampling rate listed in table B-1). This also applies to smaller silica gel tubes for aniline, cresols or methanol sampling. Chromosorb<sup>®</sup> 102 33/66 mg size tube for pesticides may be interchanged with the 50/100 mg size with no change in the recommended air volume being required. Size substitution for other adsorption tubes should generally not be made.

c. Generally, a number of different organic solvents can be analyzed from the same charcoal tube. Organic solvents requiring the same analytical procedure can be sampled and analyzed together. However, the following require a separate charcoal tube for each analysis requested:

- (1) 2-butoxyethanol (butyl cellosolve<sup>®</sup>)
- (2) t-butyl alcohol
- (3) Carbon disulfide

<sup>®</sup>Millipore is a registered trademark of Millipore Filter Corp., Bedford, MA.

<sup>®</sup>Tenax is a registered trademark of GC-Enka N.V., The Netherlands.

<sup>®</sup>Florisil is a registered trademark of Floridin Company, ITT System, Pittsburgh, PA.

<sup>®</sup>XAD-2 is a registered trademark of Rohm and Haas, Philadelphia, PA.

<sup>®</sup>Chromosorb is a registered trademark of Johns-Manville Products Corp., Denver, CO.

<sup>®</sup>Cellosolve is a registered trademark of Union Carbide Corp., 270 Park Ave, New York, NY.

- (4) 2-ethoxyethanol (ethyl cellosolve\*)
- (5) Ethyl alcohol
- (6) Ethyl ether
- (7) Isopropanol
- (8) Isobutyl alcohol
- (9) 2-methoxyethanol (methyl cellosolve\*)
- (10) Methyl bromide

d. The three stage nitrogen dioxide tubes are used both for nitrogen dioxide and sulfur dioxide. Both parameters can be analyzed from the same tube.

e. The capacity of charcoal tubes and passive monitors may be reduced by either:

- (1) High humidity (greater than 50 percent relative humidity) in combination with high ambient temperatures (greater than 85 °F), or
- (2) Very high humidity (greater than 80 percent relative humidity) with normal ambient temperatures.

To reduce the probability of breakthrough and sample loss, do not exceed one-half of the recommended maximum sample volume under the above conditions.

f. The flow rate through an adsorption tube should be determined for each individual sampling pump before field use. Only one tube needs to be used since all tubes are packed to provide a uniform pressure drop at the prescribed flow rate. For field sampling, changes in pressure drop and thus the flow rate through the adsorption tube are assumed to be negligibly affected by packing and shipping.

g. Field blank tubes will be submitted with each set of samples. If the number of samples in the set exceeds 10, then submit at the rate of one blank for every 10 samples, not to exceed 10 blanks per set. The field blank should be opened and capped; no air should be pumped through it.

h. After sampling, snugly replace plastic caps on all adsorption tubes.

\*Cellosolve is a registered trademark of Union Carbide Corp., 270 Park Ave, New York, NY.

## 2-6. Impinger sampling

a. Impinger sampling, as used in this guide, generally refers to the use of midjet impingers fitted with fritted bubbler nozzles. The one exception is ozone, which requires a standard nozzle with a 1 mm inside diameter opening.

b. Samples collected in glass fritted bubblers should be transferred to clean, glass-stoppered bottles with teflon<sup>®</sup>-lined caps. Rinse the glass fritted bubblers with a small amount of unused absorbing solution, adding the rinse to the sample.

NOTE: Samples collected for ozone analysis should be transferred to stoppered bottles with teflon<sup>®</sup> septum caps without rinsing.

c. Ground-glass surfaces and fritted bubblers used for sampling with sodium hydroxide absorbent should be thoroughly rinsed or purged with water after sampling. This prevents freezing or fusion of the ground-glass surfaces.

d. Reagent grade chemicals and high quality deionized or distilled water must be used in preparation of absorbing solutions.

e. One media blank of unused absorbing solution must be submitted with each set of samples.

## 2-7. Bulk sampling

a. Bulk sampling procedures for chemical contaminants including container type and amount of sample required are specified in table B-2.

b. When requesting an analysis for organic solvents and metals in the same sample (such as a paint), submit two portions: one for solvents and one for metals.

c. The composition of bulk "unknowns" can often be identified from the information in the Material Safety Data Sheets (MSDS). Similar information on product composition may be available through the Department of Defense Hazardous Materials Information System (DOD HMIS) (DOD 6050.5-L and DOD 6050.5-LR (limited rights)) if the national stock number is known. For those items not in the listing, obtain the MSDS for a product from its manufacturer. If the sample analysis is still required, forward the MSDS, sample and analytical request to the supporting laboratory (app D).

\*Teflon is a registered trademark of E. I. DuPont de Nemours & Co., Inc., Wilmington, DE.

## 2-8. Passive (diffusion type) monitors

### a. Organic solvent vapors

(1) Passive monitors for organic solvent vapors contain an adsorbent charcoal element similar to a charcoal tube and are analyzed similarly to a charcoal tube.

(2) The passive monitor should only be used for the contaminants in table B-1 and not for collecting unknown organic vapors.

(3) Mixtures of several solvents may be collected only if all the solvents can be analyzed on the monitor and the sampling times are similar.

(4) Manufacturers list many solvents which can be sampled with passive monitors, however, few of these are validated procedures and consequently are not included in this guide.

(5) A blank monitor (open bag, open monitor, then replace monitor in sample bag) is to be submitted with field samples. Do not intentionally expose the field blank monitor to the contaminated workplace environment. Passive monitors are not recommended for ceiling or short term exposure sampling.

### b. Ethylene oxide (ETO)

(1) Passive monitors for ETO manufactured by 3M<sup>®</sup> have been validated.

(2) Passive monitors for organic solvent vapors cannot be used for ETO.

## 2-9. Radon sampling

For radon sampling procedures, call USAEHA Health Physics Division, DSN 584-3502 or commercial 301-671-3502.

## 2-10. Field blanks

### a. The field blank:

(1) Detects a contaminant in the sorbent.

(2) Detects contamination in shipping and storage.

(3) Aids in determining interferences in the collection media.

(4) Serves as a reference in most spectrophotometric methods.

<sup>®</sup>3M is a registered trademark of Minnesota Mining and Manufacturing Co., St. Paul, MN.

b. At least one field blank must be submitted with each set of impinger, filter, adsorption tube or passive monitor samples from the same sampling series. If the number of samples in the set exceeds 10, then submit 1 blank for each 10 samples or fraction thereof. A set is one or more samples for the same contaminant(s).

c. Blanks should always be from the same lot as the sample tubes, filters or monitors. If two different lot numbers are used for sampling, then two blanks are required, one from each lot.

d. All adsorption tubes and passive monitors should be treated like samples except that they should be opened and resealed immediately. Do not intentionally contaminate the field blank.

## 2-11. Procedures for submitting samples

### a. Air samples.

(1) Complete AEHA Form 9-R (Industrial Hygiene Air Sample Data). Instructions for completing AEHA Form 9-R are in appendix E. AEHA Form 9-R is located in the back of this TG. Copies may be locally reproduced on 8 1/2- x 11-inch paper.

(2) The AEHA Form 9-R must accompany all IH samples submitted for analysis.

(3) Field personnel should establish a consecutive numbering system for assigning sample numbers. There should be no duplication of numbers from batch to batch. Number all samples including blanks.

(4) A blank must accompany all air samples, be numbered, and the word "BLANK" written on the tube, filter, bottle, passive monitor or impinger. Indicate on the form the blank sample number.

(5) In CONUS, samples may be sent directly to either: the Commander, USAEHA, ATTN: HSHB-ML-A, Bldg E-2100, APG, MD 21010-5422 or to the appropriate DSA. OCONUS activities can consult their supporting laboratory for sample analysis. See appendix D.

### b. Bulk samples.

(1) Complete AEHA Form 8-R (Bulk Sample Data). Instructions for completing AEHA Form 8-R are in appendix F. AEHA Form 8-R is located at the back of this TG. Copies may be locally reproduced on 8 1/2- x 11-inch paper.

(2) The AEHA Form 8-R must accompany all IH samples submitted for bulk analysis.

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(3) Include the manufacturer's label information and attach the manufacturer's MSDS when possible.

(4) In CONUS, samples may be forwarded directly to either the Commander, USAEHA, ATTN: HSHB-ML-A, Bldg E-2100, APG, MD 21010-5422 or to the appropriate DSA. OCONUS activities may consult their supporting laboratory for sample analysis. See appendix D.

Appendix A  
References

DOD 6050.5-L

DOD Hazardous Materials Information System Hazardous Item Listing. (This listing is available from the U.S. Army Publication Center, 2800 Eastern Blvd., Baltimore, MD 21220-2896.)

DOD 6050.5-LR

DOD Hazardous Materials Information System Hazardous Item Listing. (This listing is for U.S. Government use only limited because it contains proprietary (limited rights) data. Copies are available from the U.S. Army Publication Center, 2800 Eastern Blvd., Baltimore, MD 21220-2896.)

DA Pamphlet 525-12

Army Location Codes - CONUS.

DA Pamphlet 525-13

Army Location Codes - Foreign.

Title 49 CFR chapter 1, subchapter C  
Hazardous Materials Regulations

Title 40 CFR, part 763  
Asbestos

DHEW (NIOSH) Publication No. 75-120

Criteria for a Recommended Standard: Occupational Exposure for Crystalline Silica.

DHEW (NIOSH) Publication No. 76-105

Criteria for a Recommended Standard: Occupational Exposure to Sodium Hydroxide.

DHEW (NIOSH) Publication No. 77-140

Criteria for a Recommended Standard: Occupational Exposure to Waste Anesthetic Gases and Vapors.

DHEW (NIOSH) Publication No. 77-147A

Manual of Analytical Methods, Vol 1.

DHEW (NIOSH) Publication No. 77-157B

Manual of Analytical Methods, Vol 2.

DHEW (NIOSH) Publication No. 77-157C

Manual of Analytical Methods, Vol 3.

DHEW (NIOSH) Publication No. 78-175

Manual of Analytical Methods, Vol 4.

DHEW (NIOSH) Publication No. 79-141  
Manual of Analytical Methods, Vol 5.

DHEW (NIOSH) Publication No. 80-125  
Manual of Analytical Methods, Vol 6.

DHEW (NIOSH) Publication No. 82-100  
Manual of Analytical Methods, Vol 7.

DHHS (NIOSH) Publication No. 84-100  
NIOSH Manual of Analytical Methods, 3rd Ed., Peter M. Eller, Editor.

Note: DHEW and DHHS (NIOSH) publications are available from Publications  
Dissemination, DTS, NIOSH, 4676 Columbia Parkway, Cincinnati, OH 45226.

Appendix B

Tables

Table B-1  
Air Sampling Procedures for Chemical Contaminants

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAEHA APG procedure number
			Minimum	Maximum	
*Acetic acid	Chromosorb <sup>®</sup> tube for acids (ORB0 <sup>®</sup> -70 acid tube)	100-500 ml/min	15	60	(1)
Acetone	200/400 mg charcoal tube	20-100 ml/min	1	6	(2)
Acid mists	See specific compound				
Alkali mists (such as NaOH, KOH)	See specific compound				
Aluminum	Filter cassette, closed-face (CE 0.8 $\mu$ m filter)	1-3 L/min	100	400	(3)
*Ammonia	Ammonia tube (ORB0 <sup>®</sup> -77)	100-500 ml/min	3	24	(4)

B-2

•Chromosorb is a registered trademark of Johns-Manville Products Corp., Denver, CO.  
•ORB0 is a registered trademark of Supelco, Inc., Supelco Park, Bellefonte, PA.

\*Indicates an alternate procedure is used by USAEHA-West.

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAFER APG procedure number
			minimum	maximum	
Amyl acetate (all isomers)	200/400 mg charcoal tube	20-500 ml/min	5	40	(5)
Aniline	260/520 mg silica gel tube	200-500 ml/min	25	60	(6)
Antimony compounds	Filter cassette, closed-face (CE 0.8 $\mu$ m filter)	1-2 L/min	100	1000	(7)
Arsine	200/400 mg charcoal tube	10-20 ml/min	1	10	(8)
*Asbestos	25 $\mu$ m filter cassette, open-face shrouded with 50 $\mu$ m extension cowl (CE 0.45 $\mu$ m to 0.8 $\mu$ m filter) (See paragraph 2-2a.)	0.5-2.5 L/min	400	**	(9)
Azide	See Hydrazoic acid				
Barium compounds	Filter cassette, closed-face (CE 0.8 $\mu$ m filter)	1-2 L/min	300	2000	(10)
Benzene	200/400 mg charcoal tube	50-500 ml/min	25	40	(11)
Beryllium	Filter cassette, closed-face with spacer (CE 0.8 $\mu$ m filter)	1-4 L/min	250	1000	(12)

\*For monitoring asbestos following abatement actions, sample at 1 to 5 L/min for a sample volume between 1300 and 3000 liters. Sampling for schools must be in compliance with AHERA req. 40 CFR Part 763.

\*\*See paragraph 2-2a for further clarification.

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAFM APG procedure number
			in 1 min	maximum	
2-Butoxyethanol (Ethylene glycol monobutyl ether)	200/400 mg charcoal tube (Refrigerate after sampling)	50-500 ml/min	10	40	(13)
n-Butyl acetate	200/400 mg charcoal tube	50-200 ml/min	5	30	(5)
n-Butyl alcohol	200/400 mg charcoal tube	200 ml/min only	3.0 L only		(14)
tert-Butyl alcohol	200/400 mg charcoal tube (Refrigerate after sampling)	50-200 ml/min	2	20	(15)
Cadmium	Filter cassette, closed-face (CE 0.8 um filter)	1-3 L/min	100	1500	(16)
Carbon disulfide	200/400 mg charcoal tube	50-200 ml/min	4	40	(17)
Carbon tetrachloride	200/400 mg charcoal tube	50-500 ml/min	25	40	(18)
Chlordane (chlordane constituents)	50/100 mg Chromosorb 102 Tube	1-2 L/min	300	500	(19)
Chlorpyrifos (Dursban ●)	Specially constructed glass sampling tube containing a glass fiber filter and two sections of XAD-2 ● resin	1 L/min	480 only		(20)
Chlorobenzene	200/400 mg charcoal tube	50-250 ml/min	10	40	(18)

● Chromosorb i., a registered trademark of Johns-Manville Products Corp., Denver, CO.

● Dursban is a registered trademark of Dow Chemical Co., Midland, MI.

● XAD-2 is a registered trademark of Rohn and Haas, Philadelphia, PA.

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAEHA APG procedure number
			minimum	maximum	
Chloroform	200/400 mg charcoal tube	50-500 ml/min	25	40	(18)
Chromic acid mist and Chromium VI	Filter cassette, closed-face (PVC 5.0 $\mu$ m filter) Submit three blank filters (See para 2-4.)	1-4 L/min	100	400	(21)
Chromium (as dust or fume)	Filter cassette, closed-face (CE 0.8 $\mu$ m filter)	1-3 L/min	100	1000	(22)
Copper	Filter cassette, closed-face (CE 0.8 $\mu$ m filter)	1-3 L/min	60	1500	(23)
Cresols	260/520 mg silica gel tube	50-500 ml/min	25	40	(24)
*Cyanide	Midget impinger (10 ml of 0.2 N sodium hydroxide) (Transfer to a plastic bottle after collection.)	1.5 L/min	20	90	(25)
Cyclohexanone	200/400 mg charcoal tube	50-500 ml/min	7.5	30	(2)
Diazinon	Specially constructed glass sampling tubes containing a glass fiber filter and two sections of XAD-2 $\bullet$ resin	1 L/min	480 only		(20)
Dichlorobenzene, ortho	200/400 mg charcoal tube	500 ml/min only (ceiling)	7.5 L only		(18)
Dichlorobenzene, para	200/400 mg charcoal tube	100-500 ml/min	7.5	40	(18)

$\bullet$  XAD-2 is a registered trademark of Rohn and Haas, Philadelphia, PA.

\*Indicates an alternate procedure is used by USAEHA-West.

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAEHA APG procedure number
			minimum	maximum	
Dichlorodifluoromethane (Freon 12)	200/400 mg charcoal tube (2 tubes in series)	50-200 ml/min	0.5	5	(26)
Dieldrin (dust only)	Filter cassette, closed-face (GF 37 mm)	1.5 L/min	160	200	(27)
Diesel fuel	(see fuel oil #2)				
1,1 Dimethylhydrazine	Hydrazine tube [45-60 mes.] activated silica gel treated with 20% (by weight) conc. $H_2SO_4$	200-500 ml/min	35	100	(28)
Diethylphthalate (DOP, Di-2-ethylhexylphthalate)	Filter cassette (CE 0.8 $\mu$ filter)	1.0 L/min	30 TVA 15 peak	120	(29)
Dioxane	200/400 mg charcoal tube	50-500 ml/min	7.5	40	(30)
Dust (total)	Filter cassette, closed-face (PVC 5.0 $\mu$ filter preweighed) (Lower volumes may be necessary in very dusty locations where filters may clog.)	1-2 L/min	400	1000	(31)
Dust (respirable)	Filter cassette, with cyclone (PVC 5.0 $\mu$ filter preweighed)	1.7 L/min only	500	816	(31)
Endrin	33/66 mg Chromosorb 102 tube	1-2 L/min	30	50	(32)
Enflurane (Ethrane)	200/400 charcoal tube or Passive monitor	25-500 ml/min 1.0-8.0 hr	5	10	(33)

• Freon is a registered trademark of E. I. DuPont de Nemours and Co., Wilmington, DE.

• Chromosorb is a registered trademark of Johns-Manville Products Corp., Denver, CO.

• Ethrane is a registered trademark of Ohio Medical Products, a Division of Airco, Inc., Madison, Wisconsin 53701.

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAFHA APG procedure number
			minimum	maximum	
Epichlorohydrin	200/400 mg charcoal tube	20-200 ml/min	10	40	(34)
2-Ethoxyethanol (Ethylene glycol monoethyl ether, cellosolve●)	200/400 mg charcoal tube (Refrigerate after sampling)	100-500 ml/min	25	40	(13)
2-Ethoxyethyl acetate (cellosolve● acetate)	200/400 mg charcoal tube	100-500 ml/min	25	40	(5)
Ethyl acetate	200/400 mg charcoal tube	20-500 ml/min	2	20	(35)
Ethyl alcohol	200/400 mg charcoal tube (Refrigerate after sampling)	20-50 ml/min	0.5	2	(15)
Ethyl cellosolve●	See 2-Ethoxyethanol				
Ethylene dichloride (1,2-Dichloroethane)	200/400 mg charcoal tube	50-500 ml/min	7.5	20	(18)
Ethylene glycol dinitrate (EGDN)	50/100 mg Tenax● tube	0.2-1 L/min	15	100	(36)
Ethylene oxide (ETO)	ORBO●-78 ETO tube or 3M● passive monitor for ETO	20-200 ml/min 8 hr	9.6	20	(37)
			-	-	(38)
Ethyl ether	200/400 mg charcoal tube	50-100 ml/min	1	6	(39)

● Cellosolve is a registered trademark of Union Carbide Corp., 270 Park Ave., NY, NY.  
● Tenax is a registered trademark of GC-Enka N.V., The Netherlands.  
● ORBO is a registered trademark of Supelco, Inc., Supelco Park, Bellefonte, PA.  
● 3M is a registered trademark of Minnesota Mining and Manufacturing Co., St Paul, MN.

Material contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAEHA APC procedure number
			minimum	maximum	
Fibrous glass dust	Filter cassette, closed-face (PVC 5.0 $\mu$ m preweighed filter). Quantitative analysis performed gravimetrically; fiber identification can be confirmed qualitatively by microscope upon request. Fibrous glass samples will not be counted microscopically.	1-2 L/min	400	1000	(31)
Fluorides (Aerosol and gas)	Filter cassette, closed-face with CE 0.8 $\mu$ m filter, backed up with filter cassette, closed-face with Na <sub>2</sub> CO <sub>3</sub> -treated cellulose pad. Connect cassette with PVC tubing.	1-2 L/min	20	800	(40)
Forane (isoflurane)	200/400 mg charcoal tube or passive monitor	25-500 ml/min 1.0-8.0 hrs	5	20	(18)
*Formaldehyde	ORBO-23 formaldehyde tube	100 ml/min	24		(41)
Formic acid	ORBO-70 acid tube	100-500 ml/min	15	60	(1)
Freon 11	See Trichlorofluoromethane				
Freon 12	See Dichlorodifluoromethane				
Freon 113	See Trichlorotrifluoroethane				
Fuel oil #2	200/400 mg charcoal tube	50-500 ml/min	10	40	(201)
Gasoline	200/400 mg charcoal tube	50-500 ml/min	7.5	20	(201)

\*Freon is a registered trademark of E. I. DuPont de Nemours and Co., Wilmington, DE.

\*ORBO is a registered trademark of Supelco, Inc., Supelco Park, Bellefonte, PA.

\*Indicates an alternate procedure is used by USAEHA-West.

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAHA APG procedure number
			minimum	maximum	
Halothane	200/400 mg charcoal tube or passive monitor	25-500 ml/min 1.0-8.0 hr	5	20	(33)
Hexachloroethane	200/400 mg charcoal tube	50-200 ml/min	10	40	(18)
Hexane	200/400 mg charcoal tube	50-500 ml/min	6	40	(42)
Hexamethylene diisocyanate (HDI)	ORBO-80 filter	1 L/min	15		(43)
Hydrazine	Hydrazine tube (45-60 mesh activated silica treated with 20% (by weight) conc H <sub>2</sub> SO <sub>4</sub> )	200-500 ml/min	35	100	(28)
Hydrazoic acid (Hydrogen azide)	ORBO-70 acid tube	2 L/min only (ceiling)	30 L only	-	(1)
Hydrochloric acid	200/400 high purity silica gel tube (Inorganic acids tube) or ORBO-70 acid tube	200 ml/min only (ceiling) 500 ml/min only (ceiling)	3.0 L only 7.5 L only	-	(44)
Hydrofluoric acid	See Hydrogen fluoride				
*Hydrogen cyanide	Midget impinger (10 ml of 0.2 N sodium hydroxide). (Transfer to a plastic bottle after collection.)	1.5 L/min only (ceiling)	22.5 L only	-	(25)

•ORBO is a registered trademark of Supelco, Inc., Supelco Park, Bellefonte, PA.

\*Indicates an alternate procedure used by USAHA-West.

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAEHA APG procedure number
			minimum	maximum	
Hydrogen fluoride	200/400 mg high purity silica gel tube (Inorganic acids tube)	200 ml/min only (ceiling)	3.0	-	(44)
Hydroquinone	Filter cassette, closed-face (CE 0.8 $\mu$ m filter). Transfer filter immediately after sampling to glass vial containing 10 ml of 1 percent acetic acid.	1-3 L/min	30	180	(45)
Iron	Filter cassette, closed-face (CE 0.8 $\mu$ m filter)	1-2 L/min	15	500	(10)
Isobutyl acetate	200/400 mg charcoal tube	50-500 ml/min	5	40	(5)
Isobutyl alcohol	200/400 mg charcoal tube	50-500 ml/min	15	40	(14)
Isopropyl alcohol	200/400 mg charcoal tube (Refrigerate after sampling)	50-200 ml/min	2	12	(15)
JP-4	200/400 mg charcoal tube	50-500 ml/min	7.5	20	(201)
Kerosene	200/400 mg charcoal tube	50-500 ml/min	10	40	(201)
Lead, inorganic (fumes and dust)	Filter cassette, closed-face (CE 0.8 $\mu$ m filter)	1-4 L/min	200	1200	(46)
Lead chromate	See lead, inorganic				

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAEHA APG procedure number
			minimum	maximum	
Malathion	Specially constructed glass sampling tubes, each containing a glass fiber filter and two sections of XAD-2 resin.	1 L/min	60 L only	-	
Manganese	Filter cassette, closed-face (CE 0.8 um filter)	1-2 L/min	50	1000	(10)
Mercury vapor	Mercury vapor detector				
2-Methoxyethanol (methyl cellosolve, ethylene glycol monomethyl ether)	200/400 mg charcoal tube (Refrigerate after sampling)	100-500 L/min	25	40	(13)
Methyl alcohol	260/520 mg silica gel tube	20-200 ml/min	1	5	(47)
Methyl bromide	200/400 mg charcoal tube (petroleum base) - two tubes in series	50-200 ml/min	9	20	(48)
Methyl chloroform (1,1,1-Trichloro- ethane)	200/400 mg charcoal tube or passive monitor	20-500 ml/min 1-4 hr	1	20	(18) (200)
Methylenebis(phenyl- isocyanate) (MDI)	OR80 resin tube	1 L/min	15		(49)
Methylene chloride	200/400 mg charcoal tube	20-200 ml/min	1	12	(50)

• XAD-2 is a registered trademark of Rohm and Haas, Philadelphia, PA.  
 • OR80 is a registered trademark of Supelco, Inc., Supelco Park, Bellefonte, PA.  
 • Cellosolve is a registered trademark of Union Carbide Corp, 270 Park Ave., NY, NY.

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAEHA APG procedure number
			minimum	maximum	
Methyl ethyl ketone (MEK)	260/520 mg silica gel tube	50-500 ml/min	1	20	(51)
Methyl isobutyl ketone (MIBK)	200/400 mg charcoal tube	20-250 ml/min	1	20	(2)
Methyl methacrylate	200/400 mg XAD-2● tube	20-100 ml/min	3	6	(52)
Mineral spirits	200/400 mg charcoal tube	50-500 ml/min	5	40	(53)
Molybdenum	Filter cassette (CE 0.8 um filter)	1-4 L/min	5	60	(54)
Naphthalene	200/400 mg charcoal tube	200-500 ml/min	25	40	(11)
Nickel, soluble compounds	Filter cassette (CE 0.8 um filter)	1-2 L/min	100	1000	(10)
Nitric acid	200/400 mg high purity silica gel tube (inorganic acid tube)	200-500 ml/min	12	48	(44)
Nitrogen dioxide	Preferred: Direct reading NO <sub>2</sub> meter or 400/600/400 mg nitrogen dioxide tube (OR80●-76)	20-50 ml/min	- 2 TWA 0.75 peak	- 4	- (55)
Nitroglycerin	50/100 Tenax● tube	0.2-1 L/min	15	100	(36)

●XAD-2 is a registered trademark of Rohm and Haas, Philadelphia, PA.

●OR80 is a registered trademark of Supelco, Inc., Supelco Park, Bellefonte, PA.

●Tenax is a registered trademark of GC-Enka N.V., The Netherlands.

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAEHA APG procedure number
			minimum	maximum	
N-Nitrosodimethylamine	Thermosorb/NO air sampler (Refrigerate after sampling)	0.2-2 L/min	75 Liters recommended		(56)
Nitrous oxide	Portable infrared analyzer (e.g. MIRAN®)				(57)
M nuisance particulates	Filter cassette, closed-face (PVC, 5 µm filter preweighed)	1-2 L/min	400	1000	(31)
Oil mist	Filter cassette, closed-face (PVC 5.0 µm filter/preweighed). Analysis is performed gravimetrically.	1-2 L/min	400	1000	(31)
Ozone	Preferred: Ozone meter (direct reading) Alternate: All glass midjet impinger (10 ml of alkaline (KI). Transfer ozone samples to stoppered bottles with Teflon®- lined caps, without rinsing.	1-2 L/min	60	120	(58)
Parathion	Specially constructed glass sampling tube, containing a glass fiber filter and two sections of XAD-2® resin.	1 L/min	480	-	

- Thermosorb is a registered trademark of Johns-Manville Products Corp, Denver, CO.
- MIRAN is a registered trademark of Foxboro Analytical, South Norwalk, CT.
- Teflon is a registered trademark of E. I. DuPont de Nemours & Co., Inc., Wilmington, DE.
- XAD-2 is a registered trademark of Rohm and Haas, Philadelphia, PA.

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAEHA APG procedure number
			minimum	maximum	
Pentachlorophenol	Filter cassette, closed-face with spacer (CE 0.8 $\mu$ m filter). Followed by midjet impinger (15 ml of ethylene glycol). Note: Do not use antifreeze in place of ethylene glycol. Ship filter, backing pad, and impinger solution combined in a glass vial with Teflon-lined cap.	1.5 L/min	90	180	(59)
Pentane	200/400 mg charcoal tube	10-50 ml/min	2	4	(42)
Perchloroethylene	200/400 mg charcoal tube or passive monitor	50-500 ml/min 1-8 hr	5 TWA 2.5 peak	30 -	(60) (200)
Petroleum distillate	200/400 mg charcoal tube	50-500 ml/min	5	40	(53)
Phenol	260/520 mg silica gel tube	50 ml/min	3	20	(61)
Phosphoric acid	200/400 mg high purity silica gel tube (inorganic acids tube)	200-500 ml/min	30	120	(44)
Polychlorinated biphenyls (PCBs)	50/100 mg Florisil $\bullet$ tube preceded by 13 $\mu$ m glass fiber filter in Swinnex cassette	50-200 ml/min	12	48	(62)
Polynuclear aromatic hydrocarbons (PAH)	ORB0 $\bullet$ -43 tube preceded by 37 $\mu$ m cassette containing PTFE 2 $\mu$ m filter	2 L/min	200	1000	(63)

$\bullet$  Teflon is a registered trademark of E. I. DuPont de Nemours & Co., Inc., Wilmington, DE.  
 $\bullet$  Florisil is a registered trademark of Floridin Company, ITT System, Pittsburgh, PA.  
 $\bullet$  ORB0 is a registered trademark of Supelco, Inc., Supelco Park, Bellefonte, PA.

Chemical contaminant	Sampling method	Sampling rate or time		Sample volume in liters		USAEHA /PG procedure number
		minimum	maximum	minimum	maximum	
Potassium hydroxide	Filter cassette, closed-face (CE 0.8 $\mu$ m filter) Submit three blank filters.	60	960	1-2 L/min		(64)
n-propyl alcohol	200/400 mg charcoal tube	2	20	50-200 ml/min		(14)
Propylene dichloride (1,2 Dichloropropane)	200/400 mg charcoal tube	5	30	50-500 ml/min		(18)
Quartz (crystalline silica)	See silica, crystalline (respirable)					
Radon	Call USAEHA, Health Physics Division, DSN 584-3502					
RDX (cyclonite)	50/100 mg Tenax $\bullet$ tube	15	50	1 L/min		(65)
Silica, crystalline (respirable)	Filter cassette, closed-face and 10 mm nylon cyclone (PVC 5 $\mu$ m filter) (see paragraph 2-3)	500	1000	1.7 L/min only		(66)
Sodium azide	See hydrazoic acid					
Sodium hydroxide	Filter cassette, closed-face (CE 0.8 $\mu$ m filter) Submit three blank filters.	60	960	1-2 L/min		(64)
Stoddard solvents	200/400 mg charcoal tube	5	40	50-500 ml/min		(53)
Styrene	200/400 mg charcoal tube	5	40	50-500 ml/min		(11)

$\bullet$ Tenax is a registered trademark of GC-Enka N.V., The Netherlands.

Chemical Contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAEHA APG procedure number
			minimum	maximum	
Sulfur dioxide	400/600/400 mg nitrogen dioxide tube (OR80●-76)	20-50 ml/min	2	12	(55)
Sulfuric acid	200/400 mg high purity silica gel tube (Inorganic acids tube)	200-500 ml/min	24	48	(44)
Tetrahydrofuran	200/400 mg charcoal tube	50-250 ml/min	5	24	(67)
Titanium dioxide	Filter cassette, closed-face preweighed (PVC, 5.0 um filter)	1-2 L/min	400	1000	(31)
Toluene	200/400 mg charcoal tube	50-500 ml/min	5	40	(11)
Toluene diisocyanate (TDI)	OR80●-80 tube	1 L/min	15	-	(49)
Trichloroethylene	200/400 mg charcoal tube or passive monitor	50-500 ml/min 1-8 hr	5	40	(68)
Trichlorofluoromethane (Freon● 11)	200/400 mg charcoal tube	50 ml/min only	0.75 L only (ceiling)	-	(69)
Trichlorotrifluoroethane (Freon● 113)	200/400 mg charcoal tube	20-50 ml/min	0.5	5	(70)
Trinitrotoluene (TNT)	50/100 mg Tenax● tube 50/100 mg Tenax● with filter (custom OR80●-79)	1 L/min	15	50	(65)
Welding fumes (total fumes)	Filter, closed-face preweighed (PVC, 5.0 um filter)	1-2 L/min	400	1000	(31)

●OR80 is a registered trademark of Supelco Inc., Supelco Park, Bellefonte, PA.  
●Freon is a registered trademark of E. I. DuPont de Nemours and Co., Wilmington, DE.  
●Tenax is a registered trademark of GC-Enka N.V., The Netherlands.

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAEHA APG procedure number
			minimum	maximum	
Welding fumes (metals)	For metal analysis, see specific metal.				
White phosphorus (yellow phosphorus)	50/100 mg Tenax tube	200 ml/min	12	12	(71)
Xylenes	200/400 mg charcoal tube	50-500 ml/min	5	40	(11)
Zinc compounds	Filter cassette, closed-face (CE 0.8 $\mu$ m filter) Submit three blank filters.	1-3 L/min	15	400	(72)
Alternate collection procedures used by USAEHA-West.					
Acetic acid	50/100 mg charcoal tube	0.01-1.0 L/min	20	270	(1)
Ammonia	100/200 mg sulfuric acid treated silica gel tube	100-200 ml/min	15	70	--
Cyanide	Filter cassette (CE 0.8 $\mu$ m filter) followed by midjet impinger with 10 ml of 0.1 N KOH	0.5-1.0 L/min	10	180	--
Formaldehyde	1650/1650 alumina tube	200 ml/min	4	10	--
Hydrogen cyanide	See cyanide	--	--	--	--

• Tenax is a registered trademark of GC-Enka N.V., The Netherlands.

Table B-2  
Bulk Sampling Procedures for Chemical Contaminants

Chemical contaminant	Container requirements	Sample size
Asbestos	Screw cap; glass or plastic vial. Plastic bags are not acceptable.	1/2 inch x 1/2 inch section or larger or 1 to 10 grams
Corrosive (acidic or basic)	All glass (for acids only) or polyethylene (for acids and bases).	100 ml (unused material preferred)
Lead or chromium in paint	Screw cap; plastic container.	20-50 ml
Lead in paint chips	Screw cap; glass or plastic container.	1 gram
Organic solvents including paints	All glass container, or glass container with Teflon <sup>®</sup> -lined screw cap, or all metal can. Do not use plastic or paper-lined caps.	100 ml (unused material preferred)
Pentachlorophenol in wood	Wrap in aluminum foil.	2 inch x 2 inch sections. Do not submit sawdust.
Polychlorinated biphenyls (PCBs)	Glass container with Teflon <sup>®</sup> -lined screw cap.	1-2 ml

<sup>®</sup>Teflon is a registered trademark of E. I. DuPont de Nemours & Co., Inc., Wilmington, DE.

Table B-3  
Documentation of IH Air Sampling Procedures

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAEHA APG procedure number
Acetic acid	ORBO®-70 tube	Ion chromatography	7.0%	AIHA J. 42(6):476-478 (1981)	(1)
Acetone	Charcoal tube	Gas chromatography, FID	8.2%	NIOSH: 1300 (3rd Ed.)	(2)
Aluminum	CE filter	Atomic absorption, flame ICAP	5.8% NV	NIOSH: 7013 (3rd Ed.) NIOSH: 7300 (3rd Ed.)	(3)
Ammonia	Ammonia tube (ORBO®-77) Sulfuric acid treated silica gel tube	Ion chromatography Ion specific electrode	8.4% 8.0%	AIHA J. 47(2):135-137 (1986) NIOSH: S347 (Vol 5, 2nd Ed.)	(4)
Amyl acetate	Charcoal tube	Gas chromatography, FID	5.1%	NIOSH: 1450 (3rd Ed.)	(5)
Aniline	Silica gel tube	Gas chromatography, FID	6.0%	NIOSH: 2202 (3rd Ed.)	(6)
Antimony compounds	CE filter	Atomic absorption, flame	5.9%	NIOSH: S2 (Vol. 2, 2nd Ed.)	(7)
Arsine	Charcoal tube	Atomic absorption, graphite furnace	8.7%	NIOSH: 6001 (3rd Ed.)	(8)

®ORBO is a registered trademark of Supelco Inc., Supelco Park, Bellefonte, PA.

Chemical Contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAHA APG procedure number
Asbestos	CE filter	Microscope, counting TEM/EDXA Transmission electron microscope	25%	NIOSH: 7400 (3rd Ed.) Federal Register, Vol. 51, No. 119, EPA 560/5-85-024 AEHRA 40 CFR Part 763	(9)
Barium compounds	CE filter	Atomic absorption, flame ICAP	5.8% NV	NIOSH: 173 (Vol. 5, 2nd Ed.) NIOSH: 7300 (3rd Ed.)	(10)
Benzene	Charcoal tube	Gas chromatography, FID	5.9%	NIOSH: 1501 (3rd Ed.)	(11)
Beryllium	CE filter	Atomic absorption, graphite furnace ICAP	6.4% NV	NIOSH: 7102 (3rd Ed.) NIOSH: 7300 (3rd Ed.)	(12)
2-Butoxyethanol	Charcoal tube	Gas chromatography, FID	6.0%	NIOSH: 1403 (3rd Ed.)	(13)
n-Butyl acetate	Charcoal tube	Gas chromatography, FID	6.9%	NIOSH: 1450 (3rd Ed.)	(5)
n-Butyl alcohol	Charcoal tube	Gas chromatography, FID	6.5%	NIOSH: 1401 (3rd Ed.)	(14)
t-Butyl alcohol	Charcoal tube	Gas chromatography, FID	7.5%	NIOSH: 1400 (3rd Ed.)	(15)
Cadmium	CE filter	Atomic absorption, flame ICAP	6.0% NV	NIOSH: 7048 (3rd Ed.) NIOSH: 7300 (3rd Ed.)	(16)

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAEHA APG procedure number
Carbon disulfide	Charcoal tube	Gas chromatography, FID	5.9%	NIOSH: 1600 (3rd Ed.)	(17)
Carbon tetrachloride	Charcoal tube	Gas chromatography, FID	9.2%	NIOSH: 1003 (3rd Ed.)	(18)
Chlordane (chlordane constituents)	Chromosorb® 102 tube	Gas chromatography, ECD	7.0%	NIOSH: S278 (Vol. 6.) (2nd Ed.)	(19)
Chlorpyrifos (Dursban®)	Chromosorb® 102 tube	Gas chromatography, FPD	NV	Bulletin Environ. Contam. Toxicol (1984) 33:476-483	(20)
Chlorobenzene	Charcoal tube	Gas chromatography, FID	5.6%	NIOSH: 1003 (3rd Ed.)	(18)
Chloroform	Charcoal tube	Gas chromatography, FID	5.7%	NIOSH: 1003 (3rd Ed.)	(18)
Chloric acid mist and Corrosian VI	PVC filter	Spectrophotometry, visible	8.4%	NIOSH: 7600 (3rd Ed.)	(21)
Chromium (dust or fume)	CE filter	Atomic absorption, flame (Insol.) (Sol.) ICAP	7.6% 8.5% NV	NIOSH: 7024 (3rd Ed.)  NIOSH: 7300 (3rd Ed.)	(22)

Chromosorb is a registered trademark of Johns-Manville Products Corp., Denver, CO.  
Dursban is a registered trademark of Dow Chemical Co., Midland, MI.

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAEHA APG procedure number
Copper	CE filter	Atomic absorption, flame ICAP	4.4% (Flame) 5.1% (Dust) NV	NIOSH: 7029 (3rd Ed.) NIOSH: 7300 (3rd Ed.)	(23)
Cresols	Silica gel tube	Gas chromatography, FID	6.8%	NIOSH: 2001 (3rd Ed.)	(24)
Cyanide	Midget impinger with NaOH CE filter plus impinger with KOH	Ion chromatography Ion specific electrode	4.0% 8.1%	ASTM: STP 786 (1982:142-152) NIOSH: 7904 (3rd Ed.)	(25) --
Cyclohexanone	Charcoal tube	Gas chromatography, FID	6.2%	NIOSH: 1300 (3rd Ed.)	(2)
Diazinon	Chromosorb® 102 tube	Gas chromatography, FID	NV	Bulletin Environ. Contam. Tox (1984 33:476-483)	(20)
o-Dichlorobenzene, ortho	Charcoal tube	Gas chromatography, FID	6.7%	NIOSH: 1003 (3rd Ed.)	(18)
p-Dichlorobenzene, para	Charcoal tube	Gas chromatography, FID	5.2%	NIOSH: 1003 (3rd Ed.)	(18)
Dichlorodifluoro- methane (Freon® 12)	Charcoal tube	Gas chromatography, FID	6.4%	NIOSH: S111 (Vol. 2, 2nd Ed.)	(26)
Dieldrin (dust)	GF filter	Gas chromatography, ECD	8.6%	NIOSH: S283 (Vol. 3, 2nd Ed.)	(27)

•Chromosorb is a registered trademark of Johns-Manville Products Corp., Denver, CO.

•Freon is a registered trademark of E. I. DuPont de Nemours and Co., Wilmington, DE.

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAEHA APG procedure number
1,0-methylhydrazine	Hydrazine tube	Gas chromatography, FID	4.0%	NIOSH: 248 (Vol. 1, 2nd Ed.)	(28)
Diethylphthalate (DEP, Di-2-ethylhexylphthalate)	CE filter	Gas chromatography, FID	5.7%	NIOSH: S40 (Vol. 2, 2nd Ed.)	(29)
Dioxane	Charcoal tube	Gas chromatography, FID	5.4%	NIOSH: S360 (Vol. 3, 2nd Ed.)	(30)
Dust (total)	Prewieghed PVC filter	Gravimetric, Anal. balance	NV	In-house procedure based on NIOSH: 0500 (3rd Ed.)	(31)
Dust (respirable)	Prewieghed PVC filter	Gravimetric, Anal. balance	NV	In-house procedure based on NIOSH: 0500 (3rd Ed.)	(31)
Endrin	Chromosorb® 102 tube	Gas chromatography, ECD	7.1%	NIOSH: S284 (Vol. 6, 2nd Ed.)	(32)
Enflurane (Ethrane)	Charcoal tube or passive monitor	Gas chromatography, FID	8.0% (CT) 4.9% (PM)	AIHA J. 41(5):317-321 (1980)	(33)
Epichlorohydrin	Charcoal tube	Gas chromatography, FID	5.7%	NIOSH: 1010 (3rd Ed.)	(34)

®Chromosorb is a registered trademark of Johns-Manville Products Corp., Denver, CO.

Substance	Sampling method	Analytical method	Coefficient of variation	Reference	USAEHA APG procedure number
1,2-Dichloroethane	Charcoal tube	Gas chromatography, FID	5.9%	NIOSH: 1403 (3rd Ed.)	(13)
2-Ethoxyethyl acetate (cellosolve <sup>®</sup> acetate)	Charcoal tube	Gas chromatography, FID	6.2%	NIOSH: 1450 (3rd Ed.)	(5)
Ethyl acetate	Charcoal tube	Gas chromatography, FID	5.8%	NIOSH: S49 (Vol. 2, 2nd Ed.)	(35)
Ethyl alcohol	Charcoal tube	Gas chromatography, FID	6.5%	NIOSH: 1400 (3rd Ed.)	(15)
Ethylene dichloride (1,2-Dichloroethane)	Charcoal tube	Gas chromatography, FID	7.9%	NIOSH: 1003 (3rd Ed.)	(18)
Ethylene glycol dinitrate	Tenax <sup>®</sup> tube	Gas chromatography, ECD	8.9%	NIOSH: 2507 (3rd Ed.)	(36)
Ethylene oxide (ETO)	OR80 <sup>®</sup> -78 or 3M <sup>®</sup> Passive monitor for ETO	Gas chromatography, FID	3.5% 4.3%	ANAL. CHEM. 56:1950-3 (1984) AIHA J. 46(10):625-631 (1985)	(37) (38)
Ethyl ether	Charcoal tube	Gas chromatography, FID	5.3%	NIOSH: 1610 (3rd Ed.)	(39)

<sup>®</sup>Cellosolve is a registered trademark of Union Carbide Corp., 270 Park Ave, NY, NY.

<sup>®</sup>Tenax is a registered trademark of GC-Enka N.V., The Netherlands.

<sup>®</sup>OR80 is a registered trademark of Supelco Inc., Supelco Park, Bellefonte, PA.

<sup>®</sup>3M is a registered trademark of Minnesota Mining and Manufacturing Co., St Paul, MN.

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAFHA APG procedure number
Fibrous glass dust	Prewashed PVC filter	Gravimetric, Anal. balance	NV	In-house procedure based on NIOSH: 0500 (3rd Ed.)	(31)
Fluorides	CE filter plus Na <sub>2</sub> CO <sub>3</sub> treated filter	Ion chromatography	NV	NIOSH: 7903/7902 (3rd Ed.)	(40)
Forane	Charcoal tube	Gas chromatography, FID	NV	In-house procedure based on NIOSH: 1003 (3rd Ed.)	(18)
Formaldehyde	Formaldehyde tube Alumina tube	Gas chromatography, MPD Spectrophotometry, visible	7.3% 7.8%	OSHA 52 NIOSH: 235 (Vol. 1, 2nd Ed.)	-- (41)
Formic acid	ORBO*-70 tube	Ion chromatography	NV	AIHA J. 42(6):476-8 (1981)	(1)
Fuel oil #2	Charcoal tube	Gas chromatography, FID	NV	In-house procedure based on NIOSH: 1550 (3rd Ed.)	(201)
Gasoline	Charcoal tube	Gas chromatography, FID	NV	In-house procedure based on NIOSH: 1550 (3rd Ed.)	(201)
Halothane	Charcoal tube or passive monitor	Gas chromatography, FID	6.4% (CT) 8.4% (PH)	AIHA J. 41(5):317-21 (1980)	(33)

\*ORBO is a registered trademark of Supelco Inc., Supelco Park, Bellefonte, PA.

Chemical component	Sampling method	Analytical method	Coefficient of variation	Reference	USAEHA APG procedure number
1,1-dichloroethane	Charcoal tube	Gas chromatography, FID	12.1%	NIOSH: 1003 (3rd Ed.)	(18)
Hexane	Charcoal tube	Gas chromatography, FID	6.2%	NIOSH: 1500 (3rd Ed.)	(42)
Hexamethylene di-isocyanate (HDI)	ORBO-80 tube	Liquid chromatography, UV	7.8%	OSHA: 42	(43)
Hydrazine	Hydrazine tube	Gas chromatography, FID	4.6%	NIOSH: 248 (Vol. 1, 2nd Ed.)	(28)
Hydrazoic acid (Hydrogen azide)	ORBO-70 tube	Ion chromatography	7.3%	AIHA J. 42(6):476-8 (1981)	(1)
Hydrochloric acid	High purity silica gel tube or ORBO-70 tube for acids	Ion chromatography	5.9% 7.1%	NIOSH: 7903 (3rd Ed.) or AIHA J. 42(6):476-8 (1981)	(44) (1)
Hydrogen cyanide	Midjet impinger with NaOH CE filter plus impinger with KOH	Ion chromatography Ion specific electrode	4.0% 8.1%	ASTM: STP 786 (1982:142-152) NIOSH: 7904 (3rd Ed.)	(25) --
Hydrogen fluoride	High purity silica gel tube	Ion chromatography	11.6%	NIOSH: 7903 (3rd Ed.)	(44)
Hydroquinone	CE filter	Liquid chromatography	6.1%	NIOSH: 5004 (3rd Ed.)	(45)

•ORBO is a registered trademark of Supelco Inc., Supelco Park, Bellefonte, PA.

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAFHA APG procedure number
Iron	CE filter	Atomic absorption, flame	5.8%	NIOSH: 173 (Vol. 5, 2nd Ed.)	(10)
Isobutyl acetate	Charcoal tube	Gas chromatography, FID	6.5%	NIOSH: 1450 (3rd Ed.)	(5)
Isobutyl alcohol	Charcoal tube	Gas chromatography, FID	7.3%	NIOSH: 1401 (3rd Ed.)	(14)
JP-4	Charcoal tube	Gas chromatography, FID	NV	In-house procedure based on NIOSH: 1550 (3rd Ed.)	(201)
Kerosene	Charcoal tube	Gas chromatography, FID	NV	In-house procedure based on NIOSH: 1550 (3rd Ed.)	(201)
Lead, inorganic (fumes and dust)	CE filter	Atomic absorption, flame ICAP	7.2% NV	NIOSH: 7082 (3rd Ed.) NIOSH: 7300 (3rd Ed.)	(46)
Manganese	CE filter	Atomic absorption, flame	5.8%	NIOSH: 173 (Vol. 5, 2nd Ed.)	(10)
Mercury	Mercury vapor detector	See Manufacturer's Literature			
2-Methoxyethanol (methyl cellosolve <sup>®</sup> , ethylene glycol monomethyl ether)	Charcoal tube	Gas chromatography, FID	6.8%	NIOSH: 1403 (3rd Ed.)	(13)

<sup>®</sup>Cellosolve is a registered trademark of Union Carbide Corp., 270 Park Ave, NY, NY.

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAEHA APG procedure number
Methyl alcohol	Silica gel tube	Gas chromatography, FID	6.3%	NIOSH: 2000 (3rd Ed.)	(47)
Methyl bromide	Charcoal tube (petroleum base)	Gas chromatography, FID	10.3%	NIOSH: 2520 (3rd Ed.)	(48)
Methyl chloroform (1,1,1-Trichloroethane)	Charcoal tube or passive monitor	Gas chromatography, FID	5.4% (CT) 4.7% (PM)	NIOSH: 1003 (3rd Ed.) or AIHA J. 42(10):752-6 (1981)	(18) (200)
Methylencbis(phenyl- isocyanate) (MDI)	ORBO-80 tube	Liquid chromatography, UV	6.2%	OSHA: 47	(49)
Methylene chloride	Charcoal tube	Gas chromatography, FID	7.3%	NIOSH: 1005 (3rd Ed.)	(50)
Methyl ethyl ketone (HEK)	Silica gel tube	Gas chromatography, FID	4.0%	OSHA: 16	(51)
Methyl isobutyl ketone (MIBK)	Charcoal tube	Gas chromatography, FID	6.4%	NIOSH: 1300 (3rd Ed.)	(2)
Methyl methacrylate	XAD-2 tube	Gas chromatography, FID	6.3%	NIOSH: S43 (Vol. 6, 2nd Ed.)	(52)
Mineral spirits	Charcoal tube	Gas chromatography, FID	5.0%	NIOSH: 1550 (3rd Ed.)	(53)

•ORBO is a registered trademark of Supelco, Inc., Supelco Park, Bellefonte, PA.  
•XAD-2 is a registered trademark of Rohm and Haas, Philadelphia, PA.

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAEHA APG procedure number
Molybdenum	CE filter	Atomic absorption, flame or ICAP	4.9%	NIOSH: 7300 (3rd Ed.)	(54)
Naphthalene	Charcoal tube	Gas chromatography, FID	5.5%	NIOSH: 1501 (Vol. 3, 2nd Ed.)	(11)
Nickel, soluble compounds	CE filter	Atomic absorption, flame ICAP	5.8% NV	NIOSH: 173 (Vol. 5, 2nd Ed.) NIOSH: 7300 (3rd Ed.)	(10)
Nickel, metal	CE filter	Atomic absorption, flame ICAP	5.8% NV	NIOSH: 173 (Vol. 5, 2nd Ed.) NIOSH: 7300 (3rd Ed.)	(10)
Nitric acid	High purity silica gel tube	Ion chromatography	8.5%	NIOSH: 7903 (3rd Ed.)	(44)
Nitrogen dioxide	Direct reading NO <sub>2</sub> meter or nitrogen dioxide tube	Electrochemical sensor Ion chromatography	- 9.2%	Meter: See Manufacturer's Literature ANAL. CHEM. 53:1689-1691 (1981)	(55)
Nitroglycerin	Tenax® tube	Gas chromatography, ECD	10.4%	NIOSH: 2507 (3rd Ed.)	(36)
N-Nitrosodimethyl- amine	Thermosorb/M® Sampler	Gas chromatography	3.7%	OSHA: Method No. 27	(56)

- Tenax is a registered trademark of GC-Enka N.V., The Netherlands.
- Thermosorb is a registered trademark of Johns-Manville Products Corp., Denver, CO.

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAEHA APG procedure number
Nitrous oxide	Portable infrared analyzer (e.g., MIRAN®)			NIOSH: 6600 (3rd Ed.) See Manufacturer's Literature	(57)
Nuisance particulates	Prewieghed PVC filter	Gravimetric, Anal. balance	NV	In-house procedure based on NIOSH: 0500 (3rd Ed.)	(31)
Oil mist	Prewieghed PVC filter	Gravimetric, Anal. balance	NV	In-house procedure based on NIOSH: 0500 (3rd Ed.)	(31)
Ozone	Preferred: Ozone Meter (Direct reading) Alternate: Midget impinger (10 ml of alkaline KI)	Spectrophotometry, visible	8.0%	See Manufacturer's Literature NIOSH: S297 (Vol. 1, 2nd Ed.)	(58)
Pentachlorophenol	CE filter with midget impinger (15 ml of ethylene glycol)	High performance liquid chromatography, UV	7.2%	NIOSH: S297 (Vol. 4, 2nd Ed.)	(59)
Pentane	Charcoal tube	Gas chromatography, FID	5.5%	NIOSH: 1500 (3rd Ed.)	(42)
Perchloroethylene	Charcoal tube or	Gas chromatography, FID passive monitor	5.2% (CT) 5.6% (PM)	NIOSH: S335 (Vol. 3, 2nd Ed.) or AIHA J. 43(4):227-34 (1982)	(60) (200)
Petroleum distillates	Charcoal tube	Gas chromatography, FID	5.0%	NIOSH: 1550 (3rd Ed.)	(53)

•MIRAN is a registered trademark of Foxboro Analytical, South Norwalk, CT.

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAEHA APG procedure number
Phenol	Silica gel tube	Gas chromatography, FID	7.7%	OSHA: 16	(61)
Phosphoric acid	High purity silica gel tube	Ion chromatography	9.6%	NIOSH: 7903 (3rd Ed.)	(44)
Polychlorinated biphenyls (PCBs)	Florisil <sup>®</sup> tube plus glass fiber filter	Gas chromatography, ECD	NV	NIOSH: 5503 (3rd Ed.)	(62)
Polynuclear aromatic hydrocarbons (PAH)	ORBO <sup>®</sup> -43 tube and PTFE filter in series	High performance liquid chromatography, UV and fluorescence or Gas chromatography, FID	NV	NIOSH: 5506 (3rd Ed.) or 5515 (3rd Ed.)	(63)
Potassium hydroxide	CE filter	Atomic absorption, flame	NV	In-house procedure	(64)
Propylene dichloride (1,2 Dichloropropane)	Charcoal tube	Gas chromatography, FID	5.6%	NIOSH: 1003 (3rd Ed.)	(18)
n-Propyl alcohol	Charcoal tube	Gas chromatography, FID	7.5%	NIOSH: 1401 (3rd Ed.)	(14)
RDX (cyclonite)	Tenax <sup>®</sup> tube	Gas chromatography, ECD	6.7%	AIHA J. 42(8):587-9 (1981)	(65)

<sup>®</sup>Florisil is a registered trademark of Floridin Company, ITT System, Pittsburgh, PA.  
<sup>®</sup>ORBO is a registered trademark of Supelco Inc., Supelco Park, Bellefonte, PA.  
<sup>®</sup>Tenax is a registered trademark of GC-Enka N.V., The Netherlands.

Chemical component	Sampling method	Analytical method	Coefficient of variation	Reference	USAEMA APG procedure number
Silica, crystalline (Respirable)	PVC filter	X-ray diffraction spectrophotometry	9.0% NV	NIOSH: 7500 (3rd Ed.) In-house procedure	(66)
Sodium hydroxide	CE filter	Atomic absorption, flame	NV	In-house procedure	(64)
Stoddard solvent	Charcoal tube	Gas chromatography, FID	5.0%	NIOSH: 1550 (3rd Ed.)	(53)
Styrene	Charcoal tube	Gas chromatography, FID	5.8%	NIOSH: 1501 (3rd Ed.)	(11)
Sulfur dioxide	Nitrogen dioxide tube	Ion chromatography	9.4%	ANAL. CHEM. 53:1689-1691 (1931)	(55)
Sulfuric acid	High purity silica gel tube	Ion chromatography	8.7%	NIOSH: 7903 (3rd Ed.)	(44)
Tetrahydrofuran	Charcoal tube	Gas chromatography, FID	5.5%	NIOSH: S78 (Vol. 2, 2nd Ed.)	(67)
Titanium dioxide	Prewashed PVC filter	Gravimetric, Anal. balance	NV	In-house procedure based on NIOSH: 0500 (3rd Ed.)	(31)
Toluene	Charcoal tube	Gas chromatography, FID	5.2%	NIOSH: 1501 (3rd Ed.)	(11)
Toluene diisocyanate (TDI)	ORB0-80 tube	Liquid chromatography, UV	6.9%	OSHA: 42	(49)

•ORB0 is a registered trademark of Supelco Inc., Supelco Park, Bellefonte, PA.

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAEHA APG procedure number
Trichloroethylene	Charcoal tube or passive monitor	Gas chromatography, FID	8.2% (CT) 7.7% (PM)	NIOSH: S336 (Vol. 3, 2nd Ed.) or AIHA J. 42(10):752-6 (1981)	(68) (200)
Trichlorofluoromethane (Freon 11)	Charcoal tube	Gas chromatography, FID	7.2%	NIOSH: S102 (Vol. 2, 2nd Ed.)	(69)
Trichlorotrifluoroethane (Freon 113)	Charcoal tube	Gas chromatography, FID	7.0%	NIOSH: S129 (Vol. 2, 2nd Ed.)	(70)
Trinitrotoluene (TNT)	Tenax tube	Gas chromatography, ECD	5.3%	AIHA J. 42(8):586-9 (1981)	(65)
Welding fumes (total fumes)	Prewieghed PVC filter	Gravimetric, Anal. balance	NV	In-house procedure based on NIOSH: 0500 (3rd Ed.)	(31)
White phosphorus (yellow phosphorus)	Tenax tube	Gas chromatography, NPD	6.0%	NIOSH: 257 (Vol. 1, 2nd Ed.)	(71)
Xylenes	Charcoal tube	Gas chromatography, FID	6.0%	NIOSH: 1501 (3rd Ed.)	(11)
Zinc compounds	CE filter	Atomic absorption, flame ICAP	5.8% NV	NIOSH: 7030 (3rd Ed.) NIOSH: 7300 (3rd Ed.)	(72)

• Tenax is a registered trademark of GC-Enka N.V., The Netherlands.

• Freon is a registered trademark of E. I. DuPont de Nemours and Co., Wilmington, DE.

# Appendix C IH Monitoring Supplies and Vendors

## Section I Supplies

Table C-1  
Containers

Sampler Type	Vendor	Catalog No.
Glass container (25 ml), screw cap, Teflon® disc	Pierce	13074 (Vials)
		12422 (Teflon® Disc)
		13219 (Screw Cap)
	Alltech	9532 (Vials)
		95322 (Teflon® Disc)
		95321 (Screw Cap)
	Supelco	2-3284 (15 ml)
		2-3285 (40 ml)
Plastic bottle 30 ml (1 oz)	Most scientific supply houses	Nalge 2002 or equal

®Teflon is a registered trademark of E. I. DuPont de Nemours & Co., Inc.,  
Wilmington, DE.

Table C-2  
Filters

Sampler Type	Size (mm)	Porosity (microns)	Suggested Vendor	Catalog No.
Cellulose Ester (CE) (For asbestos)*	25	0.8	Gelman	64677
	25	0.8	Millipore®	AAWP-025-0000
	25	0.8	Nuclepore	322575 (assembled)
Cellulose Ester (CE)	37	0.8	Gelman	64678 (GN-4)
	37	0.8	Millipore®	AAWP-037-0000
	37	0.8	Nuclepore	321541 (2-piece, assembled)
Glass Fiber (For PCBs)	13	-	SKC	225-16
	37	-	Gelman	Type A/E
PTFE (Zefluor) (For PAH)	37	2	Gelman	P5PJ037
	37	2	Membrana	-
PVC	37	5	Gelman	66467
	37	5	Nuclepore	361850 filter only 240810 pad only
Swinnex Cassette (For PCBs)	13	-	Millipore®	SX 00-013-0000

\* Use 25 mm monitor with 50 mm conductive extension cowl.

®Millipore is a registered trademark of Millipore Filter Corp., Bedford, MA.

Table C-3  
Passive Monitors

Sampler Type	Suggested Vendor	Catalog No.
Ethylene Oxide	3M®	3551 (monitor only)
Organic Vapor Monitor (For selected solvents)	3M® 3M®	3500 3520 (with backup section)
Pro-Tek Air Monitoring Badge (For selected solvents)	Dupont Dupont	Type GAA Type GBB (with backup section)

®3M is a registered trademark of Minnesota Mining and Manufacturing Co., St Paul, MN.

Table C-4  
Tubes

Sampler Type	Size (mg)	Suggested Vendor	Catalog No.
Alumina	1650/1650	SKC	ST 226-64
Ammonia	250/500	Supelco	ORBO®-77
Charcoal (For solvents)	200/400	SKC	ST 226-09
	200/400	Supelco	2-0228
	50/100	SKC	ST 226-01
	50/100	Supelco	2-0267
	50/100	MDA	808101
Charcoal (For methyl bromide only)	200/400	SKC	ST 226-38-02
Chromosorb® 102 (For pesticides)	50/100	SKC	ST 226-49-23-102
	50/100	Supelco	2-0264
	33/66	Supelco	2-0262
Chromosorb® P for Acids (ORBO®-70)	165/335	Supelco	ORBO®-70
Ethylene Oxide	200/400	Supelco	ORBO®-78
Florisil®	50/100	SKC	ST 226-39
Formaldehyde	50/100	SKC	ST 226-45
Hydrazine	200/200	SKC	ST 226-42
Inorganic Acids (High Purity Silica Gel)	200/400	Supelco	ORBO®-53
	200/400	SKC	ST 226-10-03
Nitrogen Dioxide (For NO <sub>2</sub> SO <sub>2</sub> )	400/600/400	Supelco	ORBO®-76
ORBO®-70	See Chromosorb® P for Acids		
PAH (Polycyclic Aromatic Hydrocarbons)	50/100	Supelco	ORBO®-43

®ORBO is a registered trademark of Supelco, Inc., Supelco Park, Bellefonte, PA.

®Chromosorb is a registered trademark of Johns-Manville Products Corp., Denver, CO.

®Florisil is a registered trademark of Floridin Company, ITT System, Pittsburgh, PA.

Table C-4  
Tubes (continued)

Sampler Type	Size (mg)	Suggested Vendor	Catalog No.
Pesticide, OSHA	-	Supelco	Custom ORBO®-80
Silica Gel	260/520	SKC	ST 226-15
Silica Gel, High Purity	See Inorganic Acids		
Silica Gel, H <sub>2</sub> SO <sub>4</sub> treated	100/200	SKC	ST 226-10-06
Tenax®	50/100	SKC	ST 226-35-03
Tenax® with built-in filter	50/100	Supelco	Custom ORBO®-79
Thermosorb/N® Air Sampler	-	Thermedics	6533
XAD-2®	200/400	SKC	ST 226-30-06

®ORBO is a registered trademark of Supelco, Inc., Supelco Park, Bellefonte, PA.

®Tenax is a registered trademark of GC-Enka N.V., The Netherlands.

®Thermosorb is a registered trademark of Johns-Manville Products Corp., Denver, CO.

®XAD-2 is a registered trademark of Rohm and Haas, Philadelphia, PA.

Section II  
Vendors

1. Alltech Associates, Inc.  
Applied Science Labs  
2051 Waukegan Road  
Deerfield, IL 60015  
312-948-8600  
800-255-8324
2. E. I. DuPont de Nemours & Co., Inc.  
Applied Technology Division  
Wilmington, DE 19898  
215-444-4035  
800-344-4900
3. Gelman Sciences  
600 South Wagner Road  
Ann Arbor, MI 48106  
313-665-0651  
800-521-1520
4. Membrana Inc.  
7070 Commerce Circle  
Pleasanton, CA 94566-3294  
415-846-8270
5. Millipore Corp.  
Ashby Road  
Bedford, MA 01730  
617-275-9200  
800-225-1380
6. Minnesota Mining & Mfg. Co.  
Occupational Health & Safety  
Products Division  
3M Center, 220-7W-02  
St. Paul, MN 55144  
612-733-8465  
800-328-1300
7. Nuclepore Corp.  
7035 Commerce Circle  
Pleasanton, CA 94556-3294  
415-463-2530  
800-882-7711
8. Pierce Chemical Company  
PO Box 117  
Rockford, IL 61105  
815-968-0747  
800-874-3723
9. SKC Inc.  
RD 1, 395 Valley View Rd  
Eighty Four, PA 15330-9614  
412-941-7701  
800-752-8472
10. Supelco  
Supelco Park  
Bellefonte, PA 16823-0048  
800-247-6628  
814-359-3441  
814-359-3440
11. Thermedics, Inc.  
470 Wildwood St.  
PO Box 2999  
Woburn, MA 01888-1799  
617-938-3786

Appendix D  
Supporting Laboratories and Areas Served

Supporting laboratory

Commander  
U.S. Army Environmental Hygiene  
Activity-South  
Fort McPherson, GA 30330-5000  
DSN 572-3234

Commander  
U.S. Army Environmental Hygiene  
Activity-West  
Fitzsimons Army Medical Center  
Aurora, CO 80045-5001  
DSN 943-8288

Commander  
U.S. Army Pacific Environmental  
Health Engineering Agency  
Sagami  
APO San Francisco 96343  
Camp Zama 228-4111

Commander  
10th Medical Laboratory  
ATTN: AEMML-PM-LAB  
APO New York 09180  
Landstuhl Military (2223-)7272

Commander  
U.S. Army Environmental Hygiene  
Agency  
ATTN: HSHB-ML-A  
Bldg E2100  
Aberdeen Proving Ground, MD  
21010-5422  
DSN: 594-2619 (metals,  
quartz, asbestos)  
DSN: 584-2208 (solvents,  
organics, acid mists, pesticides)

Areas served

Alabama, Arkansas, Florida, Georgia,  
Western Kentucky, Louisiana,  
Mississippi, Oklahoma, Panama,  
Puerto Rico, South Carolina,  
Tennessee, Central & Eastern Texas

Alaska, Arizona, California, Colorado,  
Idaho, Illinois, Iowa, Kansas,  
Michigan, Minnesota, Missouri,  
Montana, Nebraska, Nevada, New Mexico,  
North Dakota, Oregon, South Dakota,  
West Texas, Utah, Washington,  
Wisconsin, Wyoming

Hawaii, Japan, Korea, Okinawa,  
Philippines, Thailand, and all other  
Far East countries

Europe, Africa, Middle East, Western  
Europe, Turkey, Africa, and Middle  
East countries

- a. Worldwide support to laboratories listed above
- b. Connecticut, Delaware, District of Columbia, Eastern Kentucky, Indiana, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, West Virginia

Appendix E

Instructions for Completing AEHA Form 9-R, Industrial Hygiene Air Sample Data

1. Return address: Self-explanatory.
2. Point of contact: Name and DSN of person in charge of sampling/project.
3. Samples collected by: Self-explanatory.
4. Date collected: Self-explanatory.
5. Date shipped: Date samples sent for analysis.
6. Associated bulk samples: Indicate whether bulk samples of materials used in the operation are being submitted along with corresponding air samples. If so, list the sample numbers which identify these bulks. Note: Ship bulk samples separately from air samples.
7. Project number: For USAEHA and DSA use only.
8. Sampled installation: Self-explanatory.
9. ARLOC: Army Location Code: reference - DA Pam 525-12 (CONUS) and 525-13 (Foreign).
10. Location (bldg/area): Self-explanatory.
11. Description of operation: Briefly describe the industrial operation (for example, degreasing metal parts, spray painting, vehicles, etc.).
12. Persons exposed/hrs per day: Self-explanatory.
13. Method of collection: Air sampling medium used to collect samples (for example, charcoal tube, 0.8 um CE filter, etc.).
14. Associated complaints: List worker complaints (for example, dizziness, nausea, skin irritation, etc.) about exposure problems arising from operation.
15. Analysis desired: List specific parameters when they are known or suspected to be present; otherwise, indicate general type of analysis desired (for example, unknown solvents, etc.).
16. Sampling data.
  - a. Sample number: Number assigned to the sample by field personnel.

Note: Use a consecutive numbering system so there is no duplication of numbers from batch to batch of samples. Number all samples including blanks.

b. Pump number: Identifying number for sampling pump (if used).

(1) Time on: Start time of pump (for example, 1430).

(2) Time off: Stop time of pump (for example, 1615).

(3) Total time: Sampling time in minutes (for example, 105 min).

c. Flow rate: Sampling rate of pump in liters per minute. If the initial and final calibration flow rates are different, report a volume calculated using the higher flow rate to the laboratory. If an overexposure can not be established using the higher flow rate, the industrial hygienist should recalculate the sample concentration using the lower flow rate. If the concentration using the lower flow rate exceeds the exposure limits, consider resampling.

d. Volume: Air volume sampled in liters.

e. GA/BZ: Enter GA if a general area sample or BZ if a breathing zone sample.

f. Employee name/ID: Self-explanatory.

NOTE: Protect the name and social security number; this is privacy act information.

g. Laboratory number: Leave blank.

17. Results: Lab will provide results in the common conversion (such as, parts per million, mg/m<sup>3</sup>, f/cc, etc.).

18. Comments to lab: Insert any comments or needed information on a particular sample.

19. Lab use only: Leave blank.

20. Calibration information: Self-explanatory.

21. Operation: Self-explanatory.

22. Personal protective equipment: Check box if equipment is worn. Specify type if applicable.

23. Field notes/additional comments: Self-explanatory.

Appendix F  
Instructions for Completing AEHA Form 8-R, Bulk Sample Data

1. Return address: Self-explanatory.
2. Point of contact: Name and DSN of person in charge of sampling/project.
3. Sampled installation: Self-explanatory.
4. Project number: For USAEHA and DSA use only.
5. ARLOC: Army location code - reference DA PAM 525-12 (CONUS) and 525-13 (Foreign).
6. Samples collected by: Self-explanatory.
7. Date collected: Self-explanatory.
8. Date shipped: Date samples sent for analysis.
9. Description of operation: Brief description of the industrial operation (for example, degreasing metal parts, spray painting vehicles, etc.).
10. Location (bldg/area): Self-explanatory.
11. Associated complaints: Worker complaints about exposure problems arising from operation (for example, dizziness, nausea, skin irritation, etc.).
12. Associated air samples: If air samples corresponding to these bulks are submitted for analysis, please so indicate and list the sample numbers which identify these air samples. Ship air samples separately from bulk samples.
13. Label information:
  - a. Trade name: Self-explanatory; if unknown, indicate.
  - b. NSN: If available, so indicate.
  - c. Manufacturer: Self-explanatory; if unknown, so indicate.
  - d. Address: Self-explanatory; if unknown, so indicate.
  - e. MSDS: Attach the MSDS whenever possible and so indicate.
14. Analysis desired: List specific parameters when they are known or suspected to be present otherwise, indicate general type of analysis desired (for example, unknown solvents, etc.).
15. Lab use only: Leave blank.

16. Sample number: Number that field personnel assigns to the sample number. Use a consecutive numbering system so there is no duplication of numbers from batch-to-batch of samples.
17. Constituents: Leave blank.
18. Results: Leave blank.
19. Remarks: Leave blank.
20. Comments to lab: Use for any general information or remarks you wish to include.
21. Lab use only: Leave blank.

Appendix G  
Selected Bibliography

Belkin, F. and R. W. Bishop. The New U.S. Army's Industrial Hygiene Sampling Guide. American Society for Testing Materials Special Technical Publication 957. (1987).

Bishop, R. W., T. A. Ayers and D. S. Rinehart. The Use of a Solid Sorbent as a Collection Medium for TNT and TDX Vapors. Am. Ind. Hyg. Assoc. J. 42:586-589 (1981).

Bishop, R. W., F. Belkin and R. J. Gaffney. Evaluation of a New Ammonia Sampling and Analytical Procedure. Am. Ind. Hyg. Assoc. J. 47:135-137 (1986).

Charell, P. R. and R. E. Hawley. Characteristics of Water Absorption on Air Sampling Filters. Am. Ind. Hyg. Assoc. J. 42:353-60 (1980).

Documentation of TLVs and EEIs. American Conference of Governmental Industrial Hygienists, 1988-1989.

Esposito, G. G., et al. Determination of Ethylene Oxide in Air by Gas Chromatography. Anal. Chem. 56(11): 1950-1953 (1984).

Feigley, C. E. and J. B. Chastain. An Experimental Comparison of Three Diffusion Samplers Exposed to Concentration Profiles of Organic Vapors. Am. Ind. Hyg. Assoc. J. 43:227-234(1982).

Mazur, J. F., et al. Evaluation of a Passive Dosimeter for Collection of 2-bromo-2-chloro-1,1,1-trifluoroethane and 2-chloro-1,1,2-trifluoroethyl difluoromethyl ether in Hospital Operating Rooms. Am. Ind. Hyg. Assoc. J. 41:317-321 (1980).

Mazur, J.F., et al. Evaluation of Passive Dosimeters for Monitoring Vapor Degreaser Emissions. Am. Ind. Hyg. Assoc. J. 42:752-756 (1981).

Mullins, H. E. Sub-part-per million Diffusional Sampling for Ethylene Oxide with 3M #3550 Ethylene Oxide Monitor. Am. Ind. Hyg. Assoc. J. 46:625-631 (1985).

Organic Methods Evaluation Branch, OSHA Analytical Laboratory, Method No. 16: Sampling and Analysis for 2-Butanone. Salt Lake City, Utah.

Organic Methods Evaluation Branch, OSHA Analytical Laboratory, Method No. 27: Volatile Nitrosamine Mixture 1. Salt Lake City, Utah, Feb. 1981.

Organic Methods Evaluation Branch, OSHA Analytical Laboratory, Method No. 42: Sampling and Analysis for HDI. Salt Lake City, Utah.

Organic Methods Evaluation Branch, OSHA Analytical Laboratory, Method No. 52: Sampling and Analysis for Formaldehyde. Salt Lake City, Utah.

Roper, E. M. and C. G. Wright. Sampling Efficiency of Five Solid Sorbents for Trapping Airborne Pesticides. Bulletin of Environmental Contamination and Toxicology. 33:476-483 (1984).

Rose, V. E. and Perkins, J. L. Passive Dosimetry - State of the Art Review. Am. Ind. Hyg. Assoc. J. 43:605-621 (1982).

Sax, N. I. Dangerous Properties of Industrial Materials. Van Nostrand Reinhold Company, 6th edition (1984).

Vinjamoori, D. V. and Chaur-Sun-Ling. Personal Monitoring Method for Nitrogen Dioxide and Sulfur Dioxide with Solid Sorbent Sampling and Ion Chromatographic Determination. Anal. Chem. 53:1689-1691 (1981).

Williams, K. E., G. G. Esposito, and D. S. Rinehart. Sampling Tubes for the Collection of Selected Acid Vapors in Air. Am. Ind. Assoc. J. 42:476-478 (1981).

Glossary

ACGIH

American Conference of Governmental Industrial Hygienists

APG

Aberdeen Proving Ground

ASTM

American Society for Testing and Materials

cc

cubic centimeter

CE

cellulose esters

CFR

Code of Federal Regulations

CONUS

continental United States

Cr

chromium

CT

charcoal tube

CV

coefficient of variation

DHEW

Department of Health, Education, and Welfare

DHHS

Department of Health and Human Services

DOD

Department of Defense

DSA

direct support activity

DSN

defense switched network

ECD  
electron capture detector

ETO  
ethylene oxide

FAMC  
Fitzsimons Army Medical Center

f/cc  
fibers per cubic centimeter

f/mm  
fibers per millimeter

FID  
flame ionization detector

FPD  
flame photometric detector

GF  
glass fiber

HMIS  
hazardous management information system

ICP  
inductively coupled plasma

ID  
inside diameter

IH  
industrial hygiene/hygienist

L/min  
liters per minute

LR  
limited rights

mg  
milligram

ml/min  
milliliters per minute

mm  
millimeters

min  
minute

MSDS  
material safety data sheets

NIOSH  
National Institute for Occupational Safety and Health

NPD  
nitrogen phosphorus detector

NSN  
national stock number

NV  
not validated

OCONUS  
outside continental United States

OSHA  
Occupational Safety and Health Administration

PCB  
polychlorinated biphenyls

PM  
passive monitor

PTFE  
polymer of tetrafluoroethylene

PVC  
polyvinyl chloride

TDI  
toluene diisocyanate

TEM  
transmission electron microscope

TNT  
trinitrotoluene

USAEHA TG No. 141

December 1990

TG  
technical guide

TWA  
time weighted average

TLV  
threshold limit value

USAEHA  
U.S. Army Environmental Hygiene Agency

UV  
ultraviolet

# BULK SAMPLE DATA

For use of this form see USAEEA TG 142; the proponent is ESHB-LO.

Return Address (complete address including Zip Code)		Point of Contact (name/AUTOVON)						
Sampled Installation	Project Number	ARLOC <table border="1"><tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr></table>						
Samples Collected By	Date Collected	Date Shipped						
Description of Operation		Location (BLDG/AREA)						
Associated Complaints (be specific)								
Associated Air Samples		If yes, list sample numbers						
<input type="checkbox"/> Yes <input type="checkbox"/> No								
Label Information								
Trade Name	NSN	Manufacturer						
Address		MSDS Attached						
		<input type="checkbox"/> Yes <input type="checkbox"/> No						
Analysis Desired								
Lab Use Only	Sample No.	Constituents	Results					
Comments to Lab:								
Lab Use Only								
Analyst (initials)	Reviewed by (initials)	Date Received	Date Reported					
Procedures Performed	Comments:							



Calibration Information				
Pump No.	Calibration (L/min)		Rotometer Setting	Date
	Pre-Use	Post-Use		
Name of Calibrator				
Operation				
Source of Contaminant: 				
Operation Employee(s) Perform: 				
Ventilation: <input type="checkbox"/> Local Exhaust <input type="checkbox"/> General Area <input type="checkbox"/> None				
Personal Protective Equipment (check if worn)				
<input type="checkbox"/> Respiratory Protective Equipment    Type: _____				
<input type="checkbox"/> Protective Clothing    Type: _____				
<input type="checkbox"/> Gloves    Type: _____				
<input type="checkbox"/> Goggles/Face Shield				
<input type="checkbox"/> Ear Protection				
<input type="checkbox"/> Other: _____				
Field Notes/Additional Comments				